



Aquatic Invertebrate Monitoring at Buffalo National River, 2005-2013

The Buffalo National River (BUFF) and its tributaries are located in an area of extensive karst topography, making the rivers vulnerable to contaminated groundwater recharge and interbasin transfer of groundwater from adjacent watersheds. BUFF was established to protect the corridor of the Buffalo River and its tributaries. However, the NPS jurisdictional boundary around the Buffalo River is generally a narrow corridor that encompasses only about 11% of the watershed, while over 50% of the watershed is in private ownership. This leaves much of the watershed unprotected from human activities such as timber management, landfills, grazing, livestock operations, urbanization, gravel mining, stream channelization, and removal of riparian vegetation. Although wadeable streams of the Ozarkian region, including those at BUFF, generally are in good condition, the previously noted stressors threaten their integrity (United States Environmental Protection Agency 2006).

Aquatic invertebrates are an important tool for understanding and detecting changes in ecosystem integrity, and they can be used to reflect cumulative impacts that cannot otherwise be detected through traditional water quality monitoring. The broad diversity of invertebrate species occurring in aquatic systems similarly demonstrates a broad range of responses to different environmental stressors. Benthic invertebrates are relatively easy to collect, and they can be analyzed at many different levels of precision. They are sensitive to a wide variety of impacts that occur in the Ozarks, such as changes in chemical constituents (including metals), hydrological alterations, sedimentation, bank erosion, land use, and other changes in the watershed. Furthermore, changes in the diversity and community structure of benthic invertebrates are relatively simple to communicate to resource managers, administrators, and park visitors because the loss of biological communities is of interest and concern to these groups.

There have been several previous studies conducted on stream invertebrate communities at BUFF (see Bowles *et al.* 2013 for review). Bowles *et al.* (2007) published a stream invertebrate monitoring protocol to assess aquatic invertebrate community structure at fixed sites on the Buffalo River and selected tributaries at BUFF. This protocol was designed to incorporate the spatial relationship of invertebrates with their habitat. Two broad objectives are addressed by this protocol: 1) determine the status and trends of invertebrate species diversity, abundance, and community metrics, and 2) relate the invertebrate community to overall water quality through

quantification of metrics related to species richness, abundance, diversity, and region-specific multi-metric indices as indicators of water quality and habitat condition (DeBacker *et al.* 2005). Bowles *et al.* (2013) summarized the monitoring data collected at BUFF through 2011. This report summarizes the results for monitoring conducted from 2005-2013.

Methods:

For details on methods used for invertebrate monitoring and analysis see Bowles *et al.* (2007).

Three benthic invertebrate samples were collected from each of three successive riffles at each sampling site using a Slack-Surber sampler (500 μm mesh, 0.25 m^2). The sample area was agitated for 2 minutes with a garden cultivation tool, and large pieces of substrate were scrubbed with a brush as necessary. Bulk samples were placed in plastic jars and preserved with either 99% isopropyl or 95% ethyl alcohol. Samples were sorted in the laboratory following a subsampling routine described in Bowles *et al.* (2007), and taxa were identified to the lowest practical taxonomic level (usually genus) and counted.

Invertebrate Metrics and Stream Condition Index (SCI)

The Stream Condition Index (SCI) was calculated for each site. See Bowles *et al.* (2007) for a description of the SCI and how it is calculated. SCI values of 16 or greater indicate no impairment in the invertebrate community being assessed.

Ozark Rivers Stream Invertebrate Multimetric Index (ORSIMI)

The ORSIMI was calculated for the 2013 invertebrate data collected from Buffalo River sampling sites. A description of the ORSIMI and how it is calculated is presented in DeBacker *et al.* (2012).

Water Quality and Habitat Data

Water quality and habitat data were collected in conjunction with invertebrate samples (see Bowles *et al.* 2007, 2013), but those data are not presented here because they do not allow additional insight into invertebrate community structure at this time. Those data will be presented later in a more exhaustive analysis.

Summary of Findings:

Mainstem sites

Individual metric values for sites among years varied, but showed broad overlap, which is attributed to natural variation. The high taxa richness containing a diverse assemblage of sensitive EPT and other taxa indicate that the stream condition at these sites is sound (Fig. 1). All SCI values for mainstem sampling sites in 2013 were greater than 16 indicating there was no obvious impairment at those sites prior to sampling (Fig. 2). All ORSIMI scores for mainstem Buffalo River sampling sites equaled or exceeded the baseline values for the index. ORSIMI values for BUFFM01-BUFFM03 were 100, while those of BUFFM04, BUFFM05 and BUFFM06 were 102, 105, and 101, respectively. These scores show that the aquatic invertebrate communities of the Buffalo River monitoring sites, as described by the individual metrics, have either improved or have not changed appreciably in comparison to the baseline data used to develop the index.

Tributary sites

Individual metric values for tributaries varied considerably (Table 1), but SCI values for all tributaries sampled in 2013 were greater than 16 indicating there was no obvious impairment at those sites prior to sampling (Table 2). The ORSIMI presently is not calculated for tributaries.

The overall condition of streams at BUFF are judged to be in good condition as determined by the composition of the aquatic invertebrate communities at the sites sampled. Aquatic invertebrate community structure is inherently variable and any differences observed between the 2013 sampling season and previous years is not cause for concern.

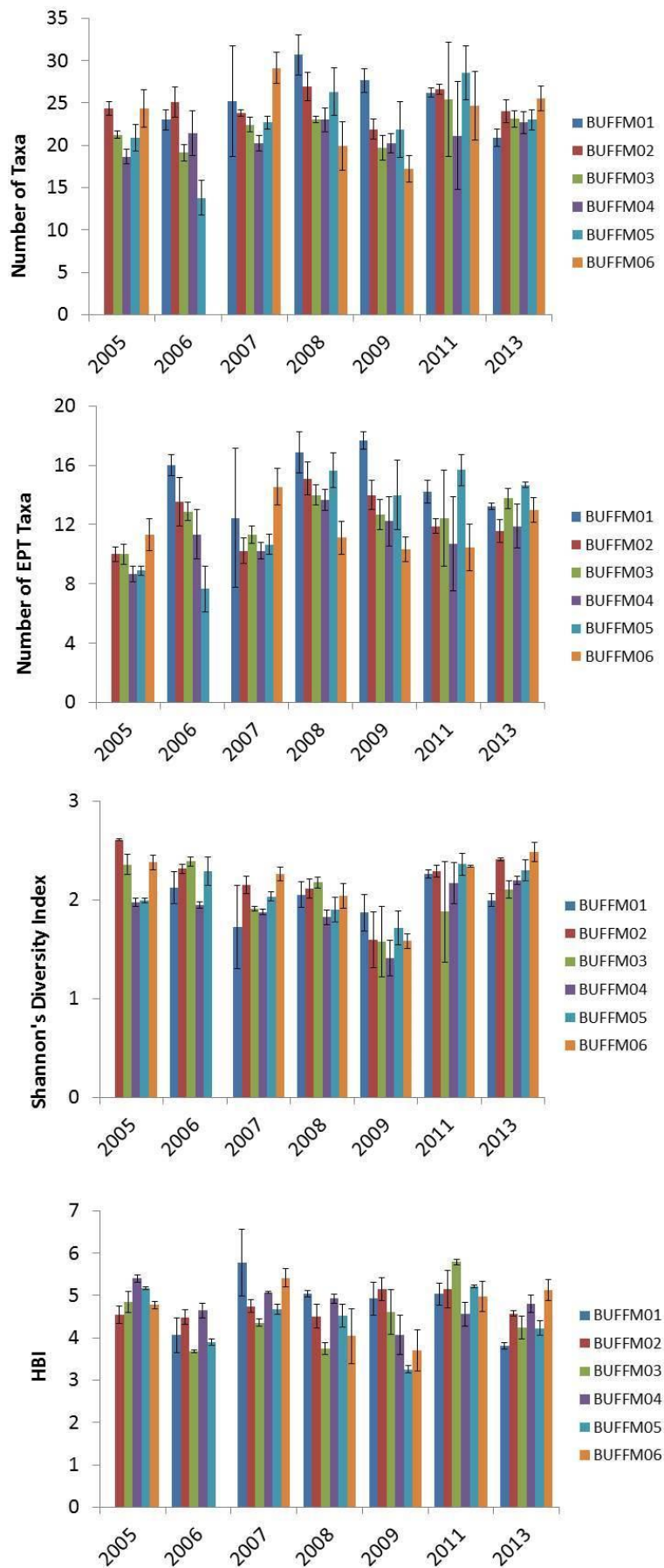


Figure 1. Aquatic invertebrate metrics for the Buffalo River, 2005-2013. Values are site means with standard errors.

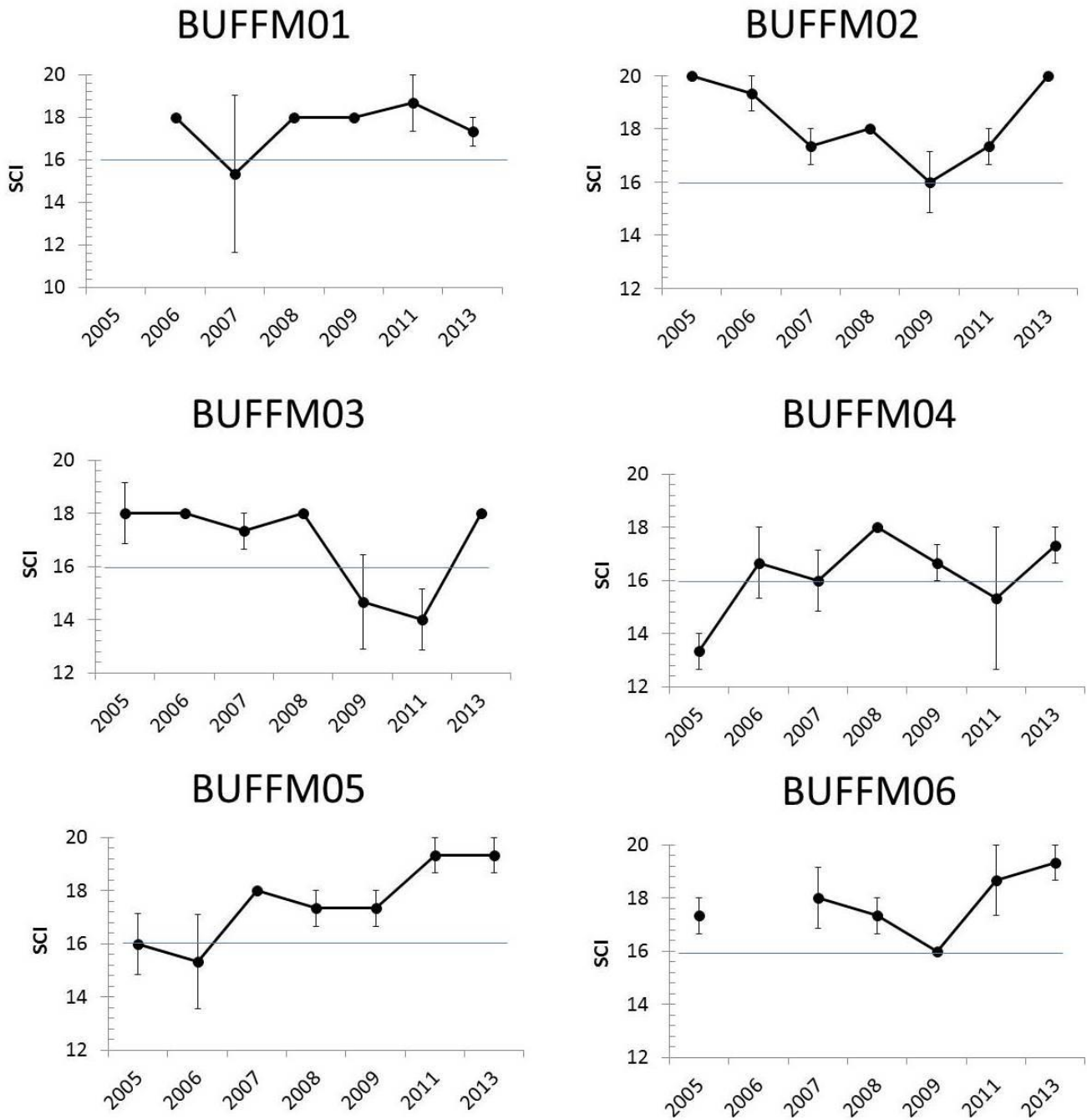


Figure 2. Mean Stream Condition Index (SCI) values for mainstem Buffalo River sampling sites, 2005-2013. Vertical bars represent standard error, and the horizontal line represents the score threshold of 16, which implies no impairment.

Table 1. Aquatic invertebrate community metric values for tributary sampling sites on the Buffalo River. Values are means with standard error in parentheses.

Site Name	Site Number	Metric	2006	2007	2008	2009	2010	2011	2013
Bear Creek	BUFFT20	Taxa Richness	—	—	—	22.11 (2.02)	—	21 (0.88)	27 (0.84)
		EPT Richness	—	—	—	14.67 (1.45)	—	12.78 (0.48)	14.22 (1.24)
		Shannon's Diversity Index	—	—	—	1.93 (0.14)	—	2.25 (0.15)	2.10 (0.13)
		HBI	—	—	—	3.94 (0.28)	—	4.611 (0.4)	4.66 (0.21)
Big Creek	BUFFT13	Taxa Richness	—	—	26.56 (1.24)	—	—	—	33.89 (2.42)
		EPT Richness	—	—	14 (1.27)	—	—	—	16 (1.64)
		Shannon's Diversity Index	—	—	1.77 (0.11)	—	—	—	2.59 (0.07)
		HBI	—	—	5.19 (0.09)	—	—	—	4.33 (0.31)
Calf Creek	BUFFT19	Taxa Richness	—	—	—	—	—	16.11 (4.55)	—
		EPT Richness	—	—	—	—	—	10.78 (2.63)	—
		Shannon's Diversity Index	—	—	—	—	—	2.01 (0.19)	—
		HBI	—	—	—	—	—	4.18 (0.21)	—
Cecil Creek	BUFFT05	Taxa Richness	—	32.33 (2.65)	—	—	—	—	33.22 (0.99)
		EPT Richness	—	12.56 (2.15)	—	—	—	—	15.44 (0.40)
		Shannon's Diversity Index	—	2.48 (0.30)	—	—	—	—	2.66 (0.02)
		HBI	—	4.828 (0.41)	—	—	—	—	4.69 (0.02)
Clabber Creek	BUFFT27	Taxa Richness	—	—	—	—	25.33 (1.02)	14.89 (2.06)	—
		EPT Richness	—	—	—	—	11.56 (0.40)	6.11 (0.59)	—
		Shannon's Diversity Index	—	—	—	—	2.13 (0.04)	1.81 (0.16)	—
		HBI	—	—	—	—	5.38 (0.03)	4.18 (0.21)	—
Davis Creek	BUFFT15	Taxa Richness	—	—	19.89 (2.02)	—	—	15.56 (1.66)	32 (2.91)
		EPT Richness	—	—	11.11 (0.99)	—	—	6.56 (1.13)	11.67 (1.50)
		Shannon's Diversity Index	—	—	1.71 (0.09)	—	—	2.24 (1.15)	2.24 (0.06)
		HBI	—	—	4.68 (0.22)	—	—	5.76 (0.22)	4.80 (0.06)
Leatherwood Creek	BUFFT31	Taxa Richness	13.44 (2.11)	—	—	—	—	16.22 (2.41)	—
		EPT Richness	5.33 (1.20)	—	—	—	—	7.67 (1.20)	—
		Shannon's Diversity Index	2.229 (0.09)	—	—	—	—	1.92 (0.11)	—
		HBI	4.62 (0.14)	—	—	—	—	5.29 (0.08)	—
Little Buffalo River	BUFFT09	Taxa Richness	19.89 (3.55)	—	—	—	—	—	26.33 (2.73)
		EPT Richness	11.78 (2.21)	—	—	—	—	—	13.56 (0.59)
		Shannon's Diversity Index	2.50 (0.16)	—	—	—	—	—	2.35 (0.11)
		HBI	4.61 (0.45)	—	—	—	—	—	4.63 (0.41)

Table 1. Continued.

Site Name	Site Number	Metric	2006	2007	2008	2009	2010	2011	2013
Middle Creek	BUFFT30	Taxa Richness	13.11 (0.78)	—	—	—	—	15.11 (0.91)	
		EPT Richness	4.22 (0.59)	—	—	—	—	5.67 (0.84)	
		Shannon's Diversity Index	1.72 (0.15)	—	—	—	—	1.5 (0.12)	
		HBI	4.82 (0.36)	—	—	—	—	3.13 (0.4)	
Mill Creek	BUFFT07	Taxa Richness	—	23.67 (0.88)	—	—	—	26.44 (2.56)	36.33 (1.20)
		EPT Richness	—	9.44 (0.40)	—	—	—	11.89 (0.87)	13.67 (0.51)
		Shannon's Diversity Index	—	2.20 (0.13)	—	—	—	2.7 (0.10)	2.40 (0.13)
		HBI	—	4.36 (0.05)	—	—	—	4.42 (0.23)	4.50 (0.03)
Water Creek	BUFFT23	Taxa Richness	—	—	—	17.56 (0.40)	—		2.11 (0.15)
		EPT Richness	—	—	—	9.33 (0.69)	—		8.22 (2.60)
		Shannon's Diversity Index	—	—	—	1.93 (0.04)	—		17.44 (3.82)
		HBI	—	—	—	5.21 (0.18)	—		4.40 (0.03)

Table 2. Stream Condition Index values for tributary sampling sites on the Buffalo River. Values are means with standard error in parentheses. A score of 16 or greater implies no impairment.

Name	Site Number	2006	2007	2008	2009	2010	2011	2013
Bear Creek	BUFFT20	—	—	—	17.33 (0.67)	—	17.33 (1.76)	18.67 (0.67)
Big Creek	BUFFT13	—	—	17.33 (0.67)	—	—	—	20 (0)
Calf Creek	BUFFT19	—	—	—	—	—	15.33 (2.40)	—
Cecil Creek	BUFFT05	—	18 (2.00)	—	—	—	—	20 (0)
Clabber Creek	BUFFT27	—	—	—	—	16.67 (0.67)	12 (0)	—
Davis Creek	BUFFT15	—	—	16.67 (0.67)	—	—	12.67 (1.76)	18.67 (0.67)
Leatherwood Creek	BUFFT31	14 (2.00)	—	—	—	—	14.67 (1.76)	—
Little Buffalo River	BUFFT09	16.67 (2.40)	—	—	—	—	—	—
Middle Creek	BUFFT30	12 (0)	—	—	—	—	13.33 (0.67)	—
Mill Creek	BUFFT07	—	18 (1.15)	—	—	—	20 (0)	19.33 (0.67)
Water Creek	BUFFT23	—	—	—	15.33 (0.67)	—	—	16.67 (1.76)

Report Prepared By:

Dr. David E. Bowles

For More Information Contact:

Dr. David E. Bowles
Aquatic Program Leader
Heartland I&M Network
6424 W. Farm Rd. 182
Republic, MO 65738
David_Bowles@nps.gov

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